

# **WQCC CONCEPT PAPER: DEVELOPMENT OF STRATEGIC WORK PLAN FOR GROUNDWATER**

# **DRAFT**

**For Discussion at September 26-27, 2011 WQCC Meeting  
Prepared by State and Regional Water Board Staff**

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## I. Introduction

This concept paper presents an overview of the major groundwater problems and challenges in California and a description of the Water Boards' current efforts to address these challenges. Further development of the concepts and draft strategies for future will be discussed at the September 2011 Water Quality Coordinating Committee meeting and will form the basis of a statewide strategic work plan for groundwater.

### Background

Groundwater represents a significant and growing portion of the State's water supply. Californians use about 15 billion gallons of groundwater a day, more than any other state in the country.<sup>1</sup> Approximately 35 percent of the water supply\* comes from groundwater during average water year conditions, with groundwater accounting for nearly 80 percent in some regions. On a statewide scale, the majority of groundwater extraction occurs in the Central Valley, especially for agricultural use, and in the urbanized areas along the South and Central Coasts.<sup>2</sup>

More than 40 percent (16 million) of Californians get their drinking water from public water systems that are entirely or partially reliant on groundwater.<sup>1</sup> Some cities, such as Fresno, Davis, Lodi, and others in the State, rely solely on groundwater for their drinking water supply.<sup>3</sup> An additional 1.6 million Californians rely on either private domestic wells or receive water from small public water systems for drinking water<sup>4</sup>.

Population growth and more intensive land use are placing an increased demand on groundwater as a source of water supply, while at the same time continuing to adversely impact groundwater quality and quantity. Future regulatory limitations on the use of surface water from the Sacramento-San Joaquin Delta and the potential for climate-related changes to the Sierra Nevada snowpack (which is projected to decline by 25 to 40 percent from its historic average by 2050<sup>5</sup>) could also result in an increased reliance on groundwater. Monitoring and managing the health and sustainability of California's groundwater is essential to protecting not only the State's agriculture but also our population.

To better address groundwater protection and management in California, a groundwater team comprised of State and Regional Water Board staff, working under the direction of the State Water Board's Executive Office, is preparing a statewide strategic work plan for groundwater. To date, only the Central Valley Regional Water Board has developed a regional strategy for groundwater quality protection.<sup>\*\*</sup> The intent of a proposed groundwater strategic work plan is to specify the approach and actions that the Water Boards will take to protect and manage groundwater by: (1) applying the Water Boards' water quality and water right authorities to address the problems that have the greatest

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\* Includes water used for municipal/domestic purpose, agriculture, and managed wetlands.

\*\* Central Valley Regional Water Board's "Groundwater Quality Protection Strategy: A "Roadmap for the Central Valley Region" (August 2010).

potential to impact beneficial uses of groundwater; (2) focusing resources on the most important groundwater problems; and (3) encouraging efforts to protect and manage groundwater at the local and regional levels.

## ***II. California Groundwater Issues: What Is Currently Being Done and What Should We Be Doing?***

Human activities, including discharge of pollutants, over-pumping, and land use practices, are adversely affecting groundwater quality, supply, and availability in the State. Salts, nitrate, pesticides, and other contaminants, including those that are naturally-occurring, from point and nonpoint sources are accumulating in groundwater basins throughout the State. Pollution from nitrate has made domestic well drinking water unsafe in parts of the State. Groundwater contamination from industrial chemicals, such as solvents and fuels, has reduced the suitability of groundwater as a drinking water source in some areas. In some instances, poor well construction can connect shallow, polluted groundwater with deeper, higher quality groundwater. Seawater intrusion is occurring in some coastal aquifers as a result of excessive groundwater pumping. Over-pumping of groundwater and reduced recharge also pose ongoing threats to long-term sustainability of our groundwater resources.

### ***Human activities adversely affect groundwater quality, supply, and availability***

- ***Discharged pollutants degrade quality***
- ***Over-pumping depletes supply and entrains poor quality water***
- ***Land use practices reduce recharge***

The groundwater team has identified three major categories of groundwater problems facing the State: (a) groundwater quality degradation due to discharges of pollutants, such as nitrate, salts, industrial chemicals, and other constituents, and due to mobilization of naturally-occurring constituents, such as arsenic and uranium; (b) lowering of water tables, permanent loss of storage capacity, seawater intrusion, and spreading of contaminated plumes due to over-pumping; and (c) reduced groundwater recharge due to changes in land use practices, which have increased impervious surface areas formerly available for recharge in urban areas, channelization, and onsite water retention. These three areas of concern (around which the groundwater strategic work plan could be organized) are described below along with the Water Boards' current efforts. In each case, the Water Boards will need to identify and secure the resources necessary to implement any new groundwater management strategies that are ultimately adopted.

***A. Historical and continuing groundwater quality degradation is limiting the use of wells, making drinking water unsafe and impacting surface waters.***

Naturally-occurring and man-made chemicals affect drinking water supplies throughout the State. The ten most frequently detected contaminants above drinking water standards (Maximum Contaminant Levels, MCLs) are arsenic, nitrate, radionuclides (gross alpha), perchlorate, uranium, tetrachloroethylene (PCE), 1,2-dibromo-3-chloropropane (DBCP), trichloroethylene (TCE), fluoride, and carbon tetrachloride.\* Arsenic, radionuclides, uranium, and fluoride are generally considered to be naturally-occurring, although human activities (mostly related to irrigation) have been shown to mobilize all but fluoride into groundwater. Sources of naturally-occurring chemicals are primarily due to the weathering of volcanic and granitic rocks. Sources of anthropogenic contaminants that occur at concentrations above MCLs, such as nitrate and perchlorate, often originate from fertilizer application to crops, septic and sewer systems, animal facilities, industrial and commercial processes, use of rocket propellants, and other activities. Confined animal facilities, and leaking septic and sewer systems, are also sources of bacteria and viruses that degrade groundwater quality in localized areas.

Communities throughout California are facing serious financial burdens and public health risks from having to rely on contaminated groundwater as their primary source of drinking water. If contaminants are detected above a regulatory level, such as an MCL, treatment or replacement of the water is required. Many of the affected communities are small, rural, and disadvantaged, and are unable to afford treatment or alternative water supplies. People drinking untreated water from private domestic wells containing contaminants are at a greater health risk because they are responsible for the quality of their own water supply. These well owners may be unaware that their water is contaminated unless they test it, and testing is not required for domestic wells in most parts of the State. Additionally, they may have few opportunities to switch to alternate sources and the cost of treatment for an individual house may be very high.

Historically, the Water Boards' groundwater quality protection efforts have focused on limiting and reducing pollution by permitting point source discharges (e.g., individual commercial or municipal activities such as landfills and wastewater treatment facilities) and by imposing cleanup requirements for unauthorized discharges (primarily legacy pollution from past land use activities such as failed gas station fuel tanks, various industries that use solvents, and military facilities). While these actions remain an important function of the Water Boards, additional approaches may be needed to address the more widespread landscape-scale challenges and pollutant sources associated with salt and nitrate contamination. Focusing on prevention of groundwater

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\* Although currently there is no MCL for hexavalent chromium (Chromium VI), which is both anthropogenic and, in some areas, naturally-occurring, it will affect a significant number of communities where it occurs at levels above the Public Health Goal (PHG) upon which an MCL will likely ultimately be based.

contamination from both point and nonpoint sources will be integral to successful groundwater management because groundwater is difficult and costly to restore once contaminated.

The following subsections address two common types of pollutants that are polluting groundwater in the State: (1) nitrate and other salts; and (2) industrial chemicals.

## 1. POLLUTION FROM NITRATE AND OTHER SALTS

Nitrate and other salts are at levels that may make the groundwater in many basins throughout the State unsafe or unusable. While accumulation of nitrate and salts in groundwater, primarily from agriculture and human waste, is inherent to the habitation of arid regions of California, these loadings must be managed\*. Nitrate pollution is widespread throughout California, and has impacted significant portions of aquifers in the southern Central Valley and Central Coast Regions, and in part of the Los Angeles Region. Nitrate pollution has made groundwater from private domestic wells unsafe to drink, and necessitated treatment and, in some cases, replacement of water from impaired municipal wells. The primary source of nitrate pollution is fertilizer from irrigated agricultural areas; lesser, local loading comes from dairies, septic systems, wastewater, food processing facilities, and other sources. Nitrate is readily soluble in water and moves easily through soil to groundwater. Current nitrate trends in basins beneath intensively-farmed areas (e.g., southern San Joaquin Valley, Salinas Valley, etc.) indicate groundwater quality will continue to worsen.

*Accumulation of nitrate and other salts in groundwater, primarily from agriculture and human waste:*

- *Has created unsafe drinking water for domestic well users in some parts of the State*
- *Is inherent to the habitation of arid regions of California*
- *Must be better managed*

Unlike other salts, nitrate can cause significant risks to public health. The health risks of nitrate pollution include methemoglobinemia or "blue baby syndrome", non-Hodgkin's lymphoma, diabetes, Parkinson's disease, Alzheimers, endocrine disruption, and cancer of the organs among adults as a result of long-term consumption exposure.<sup>6,7,8,9</sup>

In many irrigated agricultural areas, the application of fertilizers can contribute to severe nitrate contamination of groundwater that individuals and communities depend on for drinking water.<sup>10,11,12</sup> Regional Water Board staff estimates that thousands of people on the Central Coast are drinking water from wells that are contaminated with unsafe levels of nitrate, or are drinking treated or replacement

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\* "Manage" is broadly defined to include preventing pollution, minimizing pollution, treating pollution at the point of use, source removal, and cleaning up localized areas of pollution.

water to avoid drinking contaminated water. For example, data from the California Department of Public Health (CDPH) indicate that, in areas of the Salinas Valley, approximately 20 percent of the public supply wells used for drinking water exceed the safe drinking water standard for nitrate.<sup>6,13</sup> Other studies have indicated nitrate concentrations in Central Valley groundwater frequently exceed drinking water standards as well.<sup>14,15</sup> Water purveyors may not serve this water to the public until the nitrate is treated\*, resulting in significant costs to municipalities and local water agencies. Estimates for the current cost to the public for treating nitrate-polluted drinking water are in the hundreds of millions of dollars. This estimate does not account for small water systems or the hundreds of thousands of private domestic wells in California that are not regulated by CDPH.

Private domestic wells are more vulnerable to pollution because they are typically screened higher in aquifers than municipal wells and are not typically tested for contaminants, including nitrate. Many rural residents on private domestic wells are exposed to polluted drinking water because they are not aware of the water quality impacts or cannot afford treatment or replacement water. Studies in Monterey County indicate that as many as 50 percent of these wells may be contaminated by nitrate.<sup>5</sup> In 2006, the Water Board sampled 181 domestic wells in Tulare County and found that 40 percent had nitrate levels above the MCL.<sup>15</sup>

Salts other than nitrate (i.e., sodium, chloride, sulfate, etc.) also threaten the beneficial use of groundwater. Groundwater basins can also develop salt problems due to leaching of salts from overlying soils or discharge of salts from overlying land uses (i.e., agriculture, wastewater, etc.). Salts can also be introduced to a basin from imported water supplies, such as the Colorado River or the Sacramento-San Joaquin Delta. Also, many coastal groundwater basins have salt problems caused by over-pumping in the basin, which draws in brackish seawater (seawater intrusion). Excessive salt concentrations can make groundwater unsuitable for drinking water, agricultural, and industrial uses.

### **Current Water Board Efforts**

The Water Boards are using a variety of methods to address the sources of nitrate and salt loading. Waste discharge requirements (WDRs) or waivers of WDRs are established for discharges of waste to land. In some areas, the Water Boards require agricultural dischargers to demonstrate management measures that show nutrient and irrigation efficiency targeted at controlling sources of nitrate pollution, and to conduct monitoring to evaluate changes to receiving waters. For wastewater discharges, the Water Boards require, through permit conditions, that dischargers do not exceed maximum limits on the concentration of nitrate (or other nitrogen compounds) that can be discharged, and conduct monitoring to ensure these limits

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\* "Treated" includes processes to remove nitrate or to blend nitrate-contaminated groundwater with better quality water.

are being met. In addition, the State Water Board provides financial assistance to install sewer systems in areas where high densities of septic systems are polluting drinking water supplies.

To address nitrate and salt concerns in groundwater basins, the Water Boards also: (a) encourage and participate in salt and nutrient management plan development; (b) promote the use of recycled water to offset the need for pumping or to recharge aquifers; (c) limit the use of salt additions from certain types of water softeners in salt-impacted basins; and (d) promote the importation and percolation of low-salt waters to contaminated groundwater basins. The Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) program, which is modeled after the Santa Ana Regional Water Board's comprehensive salt and nitrate plan for their entire drainage basin, is a noteworthy collaborative basin planning effort aimed at developing and implementing a comprehensive salinity and nitrate management program. In 2006, the Central Valley Water Board, the State Water Board, and stakeholders initiated this joint effort to address salinity and nitrate problems in California's Central Valley, and to adopt long-term solutions that will lead to enhanced surface and ground water quality and economic sustainability. An expansion of the effort culminated in the Region's August 2010 groundwater strategy<sup>16</sup>, and groundwater protections through the Region's irrigated lands program and 2007 dairy order.

The Water Boards' Groundwater Ambient Monitoring and Assessment (GAMA) Program is California's comprehensive groundwater quality monitoring program. GAMA includes four active projects that assess groundwater quality in the State. The GAMA Domestic Well Project samples domestic wells for commonly detected chemicals, at no cost to well owners who volunteer. Results are shared with the well owners and used to evaluate the quality of domestic well water. The Domestic Well Project has sampled over 1,100 private wells in six counties of focus in California as of 2011. The GAMA Priority Basin Project assesses groundwater quality in key groundwater basins that account for over 90 percent of all groundwater used in the State. Through this project, groundwater is monitored for hundreds of chemicals, including emerging contaminants such as pharmaceuticals and personal care products. Since 2004, over 2,200 public supply zone wells have been tested by the U.S. Geological Survey (USGS). Under the GAMA Special Studies Project, Lawrence Livermore National Laboratory has conducted several groundwater special studies pertaining to nitrate, wastewater, and groundwater recharge.

Groundwater monitoring data is stored in GeoTracker GAMA, the Water Boards' online groundwater information system that allows public access to groundwater water quality data and provides basic information on groundwater quality and protection. GeoTracker GAMA has data from over 200,000 discrete well locations, including over 100 million analytical results, well logs, and water levels.

## 2. POLLUTION FROM INDUSTRIAL CHEMICALS

Discharges of industrial chemicals, such as volatile organic compounds, solvents, fuels, pesticides, metals, and other chemicals, have degraded local groundwater quality throughout the State. This pollution is currently addressed through both prevention measures to avert future impacts, improved regulatory action for ongoing dischargers who are polluting or threatening to pollute groundwater, and cleanup actions to mitigate impacts caused by historical practices.

*Groundwater degradation from discharges of industrial chemicals is:*

- *Preventable*
- *Should be addressed through prevention and cleanup actions*

Groundwater basins throughout the State have localized impacts from various sources such as manufacturing sites, leaking underground storage tanks, and chemical spills located primarily around urban and commercial land use areas. An example is the legacy\* impacts from dry cleaners that used solvents such as PCE. The extent of these types of pollutant plumes are generally localized and not as widespread as those for nitrate and other salts (described in the section above) because the releases are typically from smaller point sources rather than larger nonpoint sources. However, the contaminants are concentrated and groundwater impacted by these releases can have significant impacts on human health.

Prevention measures, such as enhanced leak detection methods for both industrial materials storage tanks and piping, improved materials handling procedures, and the identification and use of less toxic chemical alternatives in manufacturing processes, can be implemented to help lessen future threats to groundwater quality. These prevention measures are typically less costly and more easily implemented than after-the-fact groundwater cleanup.

Although preventative measures can help alleviate future impacts to groundwater, many of the legacy sites that currently threaten or impact drinking water supplies require cleanup measures to reduce immediate threats to human health and the environment. These cleanup measures are often successful in addressing source removal of contaminants, but it can be either too costly or technically infeasible to completely clean up these sites to background or other low regulatory levels.

Contaminants that float on the water table (e.g., petroleum fuels) are generally easier to clean up than dense contaminants (e.g., dry cleaning solvent) that sink deeper below the water table. Also, materials that tend to naturally degrade in the environment are easier to clean up over the long-term than materials that are resistant to natural degradation. For example, chlorinated solvents (such as from dry cleaning solvent PCE dissolved into groundwater) typically pose greater threats

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\* "Legacy" refers to persisting pollution from past practices.

to drinking water supplies than do petroleum fuels, depending on environmental and site-specific factors.

The industrial solvents PCE and TCE, and the soil fumigant DBCP, are the most frequently detected volatile organic compounds (VOCs) in drinking water wells at levels above MCLs.\* PCE and TCE are highly toxic and typically mobile in groundwater. Other compounds, such as the fuel oxygenate MTBE, are also highly mobile in groundwater, and affect the taste and odor of groundwater, making it unsuitable for consumption. Perchlorate, a manufactured salt typically used in rocket fuels and road flares, has impacted supply wells in a number of groundwater basins throughout the State. Groundwater affected by these types of compounds often require costly cleanup to both restore the usability of the groundwater and to prevent further impacts to additional groundwater resources. Actions on these industrial releases by local and State oversight agencies, such as the Regional Water Boards, have helped to prevent degradation of deeper drinking water aquifers.

Some pesticides from agricultural, residential, and commercial use that have been detected in groundwater include DBCP, ethylene dibromide, simazine, and their degradation products. Emerging contaminants, such as pharmaceuticals and personal care products (e.g., sunscreen, vitamins, cosmetics, and fragrances) also have the potential to adversely impact groundwater. Additionally, naturally-occurring metals in groundwater affect water quality in widespread areas of the State, including arsenic (which is found in the minerals within the sediments of aquifers), hexavalent chromium, and uranium (which is found in the minerals of Sierran granitic rocks).

While drinking water from public supply wells is typically treated (removed or blended) so consumers are not exposed to contaminated water at unsafe levels, affected individuals and communities in the State have to contend with treatment costs associated with these chemicals; those costs, in turn, are transferred to the rate payers.

### **Current Water Board Efforts**

The Water Boards use a variety of methods to regulate discharges that can adversely affect groundwater. These methods include protection measures such as prescribing waste discharge requirement as well as taking steps to remediate groundwater quality impacted by pollution. More recent efforts include coordination among other agencies, including the California Department of Toxic Substances Control, on existing “green chemistry” efforts to identify less toxic alternatives to commonly used industrial chemicals.

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\* It should be noted that while the VOC benzene is widely detected in shallow aquifers adjacent to site cleanups, there are very few public drinking water wells that have benzene above the MCL.

Two primary approaches taken to address industrial chemicals in groundwater are pollution prevention and groundwater cleanup with re-injection. Pollution prevention measures have significantly limited releases from newly-constructed landfills and other Title 27 regulated facilities, wastewater discharges to groundwater, and underground storage tanks. Pollution prevention avoids the permanent damage from most releases to groundwater and the very high costs of remediation. Pollution prevention standards are required in statute and regulations, such as requirements for improved containment, and monitoring of underground storage tanks, landfills, and other sources.

The Water Boards have been working toward preventing or minimizing impacts to groundwater from industrial pollutant sources by issuing WDRs or waivers of WDRs. Title 27 regulations prescribe requirements for those waste discharges to land that must be contained and for those that only need to meet Basin Plan water quality objectives, depending on the waste type. They also require groundwater monitoring for wastes that are required to be contained or allowed to be percolated to groundwater.

For wastewater discharges, the Water Boards require, through permit conditions, that dischargers: (a) adhere to maximum limits on the concentration of contaminants that can be discharged; and (b) in most cases, conduct groundwater monitoring to ensure these limits are being met. The Water Boards' antidegradation policy (Resolution 68-16) is relevant to minimizing degradation to groundwater from discharges.

Industrial waste discharges (from sources such as dry cleaners, gas stations, landfills, and wastewater discharges) have been regulated for many years, and many of these contaminants have been removed through groundwater pumping and re-injection. Millions of dollars are spent each year in cleanup, and in Water Board oversight of cleanup, of leaks and spills of petroleum, solvents, and other industrial chemicals. Groundwater cleanup and re-injection has been costly and is more expensive than wellhead treatment just prior to its use; however, wellhead treatment potentially transfers the cost from the discharger to the user. In addition, far fewer drinking water wells are impacted by these industrial chemicals than are impacted by nitrate.

The Water Boards oversee the investigation and remediation of current or historical unauthorized discharges to soil and groundwater, contaminant source removal, soil and groundwater treatment, and monitoring. Water Board cleanup efforts are concentrated in three main programs: (a) the Site Cleanup Program, which focuses on releases from regulated industrial and disposal facilities (i.e., not petroleum underground storage tanks and not military facilities); (b) the Department of Defense (DOD) Program; and (c) the Underground Storage Tank (UST) Program.

Site Cleanup Program. The Site Cleanup Program, which is primarily funded by cost recovery, is one of the Water Boards' three groundwater cleanup programs that focus on industrial- and disposal-type releases (i.e., not petroleum underground storage tanks and not military facilities). The Water Boards oversee responsible parties' investigation and remediation of current or historic unauthorized discharges to soil, groundwater and surface water, such as site investigations, source removals, soil and groundwater treatment and monitoring.

DoD Program. The Water Boards' DoD Cleanup Program, which is funded by Department of Defense Reimbursement (DoD) and Federal Cost Recovery (F-CR), protects water quality from releases at active and closed military facilities. The Water Boards oversee investigation and remediation.

UST Program. The Water Boards' UST Program, which is funded by the UST Cleanup Fund and a USEPA grant, has three elements: (a) groundwater cleanup to protect public health and safety, and the environment from releases of petroleum and other hazardous substances, from USTs; (b) pollution prevention related to the construction and inspection of USTs; and (c) UST cleanup fund administration for UST cleanup oversight and reimbursements to responsible parties for up to \$1.5 million in cleanup costs per release.

Monitoring. Groundwater monitoring data from water supply wells and cleanup sites (primarily leaking USTs as well as landfills) are electronically submitted to GeoTracker, where it and GeoTracker GAMA serve co-located data on groundwater quality and contaminant sources. Sharing these data with the public and regulators allows for better decisions in all areas of groundwater management including prioritizing groundwater cleanup cases and choosing appropriate strategies.

## ***B. Inadequate management of groundwater pumping is leading to water quality and supply impacts in certain areas.***

Unmanaged and unsustainable pumping can result in depletion of groundwater resources, land subsidence and associated permanent loss of storage capacity, and reduced surface water flows. The USGS estimates that almost 60 million acre-feet of groundwater has been depleted in the Central Valley from about 1962 to 2004 and that there has been over 30 feet of subsidence in the San Joaquin Valley.<sup>17</sup> Once subsidence occurs, an aquifer becomes compacted and the storage space that is lost generally cannot be regained. This problem exists throughout California, especially in the southern part of the State.

### ***Unmanaged and unsustainable pumping can result in:***

- ***Depletion of groundwater resources***
- ***Land subsidence and permanent loss of storage capacity***
- ***Reduced surface water flows***

Data concerning aquifer depletion is difficult to obtain since one of the best sources would be water level and pumping data from private agricultural and municipal wells. Historically, landowners have not been required to provide this information, and lack of comprehensive groundwater quality and pumping data is an impediment to planning and management.

Groundwater depletion can also cause shallow groundwater wells to go dry and increase the energy cost of pumping. Unmanaged pumping in some areas is causing intrusion of

*Unmanaged pumping in some areas is causing intrusion of seawater or poor quality water*

seawater or poor quality water. In coastal areas specifically, the loss of groundwater can cause seawater to intrude into the aquifer, making the water unsuitable for use. This condition is difficult to reverse once it occurs. In many areas

of the State, a well's pumping may also cause polluted groundwater to spread faster and be drawn into areas with clean groundwater and into wells that would otherwise not be impacted. Also, where poor well construction has connected shallow, polluted groundwater with deeper, higher quality groundwater, increased pumping can enhance this effect.

Management of groundwater extraction is difficult at the State level because the State Water Board's water right permitting authority is limited to diversion of surface water and subterranean flow in known and definite channels (see Water Code div 2, §1200). Percolating groundwater is not subject to water right permitting authority. Determining whether a specific pumping operation is subject to water right permitting authority is often contentious and time consuming. Due to the often difficult determination of percolating groundwater versus water flowing in an underground channel, it is not unusual for parties to illegally divert groundwater flowing in an underground stream. This class of groundwater is also the most likely to be hydraulically connected to the base flow component of a surface stream. Pumping of underground streams can reduce surface water flow and, in turn, impact public trust resources such as fisheries, as well as water available for authorized beneficial uses.

### **Current Water Board Efforts**

Data collection is improving within State water management agencies. The California Statewide Groundwater Elevation Monitoring (CASGEM) program is developed and maintained by the DWR with the intent of establishing a permanent, locally-managed program of regular and systematic monitoring in all of California's alluvial\* groundwater basins. DWR's role is to coordinate the CASGEM program and work cooperatively with local entities to maintain the collected elevation data in a readily and widely available public database. Through the GeoTracker GAMA program, the State Water Board provides access to the CASGEM database as well as DWR's Integrated Water Resources

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\* Alluvial groundwater basin refers to groundwater that is hydrologically connected to a surface stream that is present in permeable geologic material, usually small rock and gravel.

Information System (IWRIS), USEPA's Water Data Finder Program, and the USGS's National Water Information System. The USGS is also developing remote sensing capabilities to track subsidence and groundwater depletion. Despite improvements in data management and availability, the State's two primary groundwater data programs (CASGEM and GAMA) are not integrated.

A wide array of local and regional water agencies currently manage groundwater resources throughout the State. In many cases, these efforts are successful because local and regional management districts are most knowledgeable about local conditions<sup>5</sup> and may have the management infrastructure, governance systems, and funding mechanisms in place to address specific challenges that confront them. There are many examples of successful local efforts to manage groundwater in California, but in some cases these efforts have been prompted by legal action. The California Water Code encourages local management of groundwater basins and specifies guidelines for development of groundwater management plans (Water Code div 6, part 2.75). Success in developing and implementing these plans is largely dependent upon cooperation between local agencies and is not always attainable. Although the Water Code also authorizes local agencies to fix and collect fees to manage groundwater under an adopted plan, adoption of a fee is subject to a local election. As we have seen in the Pajaro Valley, obtaining support for the fees is difficult when land owners may currently enjoy unrestricted pumping. Challenges to local fees based on Proposition 218<sup>\*</sup> have also made local management of groundwater difficult to implement.

Water Code section 2100 gives the State Water Board authority to adjudicate a groundwater basin to protect water quality, but adjudications are time-consuming and require either new staff resources specifically devoted to this effort or diversion of staff from other work. There is no authority to adjudicate or otherwise regulate pumping in cases of unsustainable pumping or subsidence, unless it can be linked to water quality problems, or to waste and unreasonable use of water or unreasonable method of diversion. It has also been suggested that the decisions regarding the State Water Board's permitting authority over groundwater have focused too narrowly on the physical boundaries (bed and banks) of subterranean streams and that application of an impact test<sup>\*\*</sup> would be a more accurate interpretation of legislative intent<sup>18</sup>.

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<sup>\*</sup> Proposition 218, approved by the State's voters in 1996, was a constitutional initiative that changed local government finance. [http://www.lao.ca.gov/1996/120196\\_prop\\_218/understanding\\_prop218\\_1296.html#appendixII](http://www.lao.ca.gov/1996/120196_prop_218/understanding_prop218_1296.html#appendixII)

<sup>\*\*</sup> A test to measure the impact of groundwater diversion on surface water flow.

### ***C. Increased impervious surfaces and channelization have reduced groundwater recharge.***

Protection of natural recharge areas and processes is necessary for maintaining groundwater supply and quality; however, many recharge areas are being impacted by urbanization.<sup>2</sup> Natural recharge areas

include wetlands, lakes, rivers, floodplains, and land areas with high soil permeability. As areas become urbanized, the amount of impervious surfaces (e.g., rooftops, roads, parking lots, etc.) grows and natural drainages can become channelized to accommodate infrastructure and provide flood protection. These activities increase

the rate and volume of water moving off the land and generally reduce opportunities for water to percolate into the ground. Furthermore, onsite retention of surface waters to increase local water supplies for later use reduces infiltration to groundwater.

***Urbanization and other land use practices have increased impervious surfaces, channelization, and onsite water retention, resulting in:***

- ***Reduced groundwater recharge***
- ***Modified surface water flows***

Storm water runoff is traditionally managed by collecting and conveying rainfall through a system of storm drains, pipes, or other conveyances for discharge to surface waters. Water is quickly and efficiently moved through these collection and conveyance systems to reduce standing water on roadways and around structures. The storm sewer systems were designed with flood control in mind. This mindset treated runoff as only a waste (something to move off of the landscape to a receiving water as fast and effectively as possible to not cause flooding), not a resource that naturally occurred and recharged groundwater. Land use modification (urbanization and development) has altered the natural hydrologic functions and processes which, in turn, reduced rainfall infiltration and storage into the ground. Groundwater supplies in the urban environment are generally not replenished or recharged from storm water due to these practices.

Through conjunctive management,<sup>\*</sup> storm water, recycled waste water, and imported water may be stored in groundwater by the use of spreading basins or injection wells, and then extracted and beneficially used at a later time. Accordingly, conjunctive management can potentially be used to offset recharge losses caused by reduced groundwater infiltration in urban areas. There are several facilities in southern California, for example, that replenish groundwater with recycled water. Some apply filtered, disinfected secondary recycled water onto spreading basins. Some inject recycled water that is treated using reverse osmosis and advanced oxidation into aquifers, primarily to create seawater intrusion barriers. DWR estimates that conjunctive management could increase the water supply by 0.5 to 2.0 million acre-feet

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<sup>\*</sup> “Conjunctive management” refers to the planned and coordinated use and management of groundwater and surface water resources to maximize availability and reliability of water.

per year.<sup>2</sup> Conjunctive management, and the use of recycled water in particular, however, have the potential to contaminate groundwater supplies if not properly implemented.

### **Current Water Board Efforts**

The State Water Board has long recognized that sustainability is a key to ensuring that there is an adequate water supply for the State. The Water Board funded and actively participated in the development of the “Ahwahnee Water Principles, a Blueprint for Regional Sustainability”. Included in the principles are maximizing permeability in the urban environment and water recycling. In 2005, the State Water Board adopted Resolution No. 2005-006 that adopted sustainability as a core value of the Board. This resolution was later modified to recognize low impact development (LID) as a key component of sustainable practices.

In its Proposition 84 Storm Water Grant Program Guidelines adopted in 2009, the State Water Board defined LID to be “a storm water management strategy aimed at maintaining or restoring the natural hydrologic functions of a site or project to achieve natural resource protection objectives and fulfill environmental regulatory requirements; LID employs a variety of natural and built features that reduce the rate of runoff, filter pollutants out of runoff, and facilitate the infiltration of water into the ground and/or on-site storage of water for reuse.”

The Water Boards have taken steps toward sustainability by including LID and specific hydromodification requirements in all MS4 permits. The Water Boards are also developing policy that will address the protection of wetlands and are working on the development of hydromodification tools.

All municipal storm water permits also now include the Standard Urban Storm Water Mitigation Plan (SUSMP) requirements, which address post-construction storm water quality. The SUSMP requirements have resulted in newly-developed sites in Los Angeles being required to construct post-construction storm water controls where storm water is either infiltrated or captured for onsite use. There are also projects that have been constructed where the first flush of a storm (thought to be the most polluted) is treated before discharge or is diverted to the sanitary sewer. The State Water Board is also in discussions with the California Department of Transportation (Caltrans) about LID practices that can be incorporated into their permit. Funding and implementation of LID projects is encouraged through various State Water Board grant programs.

Efforts continue at the local and regional levels to promote and implement LID. The State Water Board is partnering with other agencies, organizations, and universities to protect natural resources by providing technical information and tools for informed land use decision-making at the local level. The Water Boards are also providing advocacy and outreach to local governments through the Water Boards’ Training Academy.

### **III. Questions**

- 1. Does it make sense to organize the groundwater strategic work plan around the following three problem areas?**
  - a. Groundwater quality degradation due to discharges of pollutants, such as nitrate, salts, industrial chemicals, and other constituents;
  - b. Lowering of water tables, permanent loss of storage, and seawater intrusion due to over-pumping; and
  - c. Reduced groundwater recharge due to changes in land use practices, such as increased impervious surface area, channelization, and onsite water retention.
- 2. Are there other organizational approaches for the work plan that should be considered?**
- 3. Are there additional groundwater concerns that should be addressed in the work plan?**
- 4. Are there additional groundwater management strategies that should be evaluated and included in the work plan?**
- 5. Are there strategies in this concept paper that should not be considered for the work plan?**

**APPENDIX 1**

**State and Regional Water Boards  
Groundwater Strategic Work Plan Team**

| <b>Team Member</b> | <b>Organization</b> |
|--------------------|---------------------|
| Barbara Evoy       | DWR                 |
| Bruce Fujimoto     | DWQ                 |
| Dorena Goding      | ORPP                |
| Dyan Whyte         | Region 2            |
| Eric Oppenheimer   | ORPP                |
| Gail Linck         | ORPP                |
| Holly Lundborg     | Region 1            |
| Jim Kassel         | DWR                 |
| John Anderson      | Region 9            |
| John Borkovich     | DWQ                 |
| John Robertson     | Region 3            |
| John Russell       | DFA                 |
| Ken Harris         | DWQ                 |
| Kevin Graves       | DWQ                 |
| Larry Lindsay      | DWR                 |
| Leslie Graves      | DWQ                 |
| Lisa Babcock       | DWQ                 |
| Liz Haven          | DFA                 |
| Richard Booth      | Region 6            |
| Shahla Farahnak    | DWQ                 |
| Todd Thompson      | DWQ                 |
| Vicky Whitney      | DWQ                 |
| Yue Rong           | Region 4            |

| <b>Advisors</b> | <b>Organization</b> |
|-----------------|---------------------|
| Jonathan Bishop | Exec                |
| Caren Trgovcich | Exec                |

**APPENDIX 2**

**ENDNOTES:**

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- <sup>15</sup> State Water Resources Control Board. 2010. Groundwater Ambient Monitoring and Assessment (GAMA) Domestic Well Project Groundwater Quality Data Report; Tulare County Focus Area. Sacramento, CA. Groundwater Protection Section.
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- <sup>17</sup> Faunt, C.C. 2009. Groundwater availability of the Central Valley aquifer. U.S. Geological Survey (USGS) Professional Paper 1755. 225 pp.
- <sup>18</sup> Sax, J. 2002. Review of the laws establishing the SWRCB's permitting authority over appropriations of groundwater Classified as subterranean streams. California State Water Resources Control Board, No., 0-76-300-0, Final Report, January 2002. 104 pp.